Heterogeneity of the Maghreb: the results of optimized monetary rules

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Abstract
Purpose - The launch of the euro has fueled doubts concerning the constitution of an optimal European monetary zone. Indeed, the differences in legal, institutional and cultural frameworks... as well as the diversity of the productive and financial European systems may have led to the idea that Europe does not constitute a viable monetary zone.
In Africa, the decision of African Central Bank governors to adopt a single currency by 2021 and the call from the union of Maghreb banks since 2002 to create one currency for the Maghreb (Algeria, Libya, Morocco, Mauritania and Tunisia) raises the same doubts as to the efficiency of such decisions.
Methodology - In this work, we have tried to evaluate implicitly the pertinence of such decision by showing in a first section the heterogeneity of Maghrebian monetary regimes. We have tried to illustrate in a second section this heterogeneity via a model describing the functioning of the economy of these countries. Finally, we have attempted to show in a third section the consequences of these heterogeneities by simulating optimal monetary rules defined for each country.
Findings - Our results suggest that these countries will need different (and sometime divergent) Taylor rules and that the decision to belong to the same monetary union where a common monetary policy will be conducted proved to be unsuitable.
Keywords: Monetary policy, Exchange rate, Heterogeneity, Optimization, Taylor rule, Maghreb
Paper type: Research Paper

Introduction

The launch of the euro has fueled doubts concerning the constitution of an optimal European monetary zone. Indeed, the differences in legal, institutional and cultural frameworks… as well as the diversity of the productive and financial European systems may have led to the idea that Europe does not constitute a viable monetary zone.
The idea behind this reasoning is that the conduct of a unique monetary policy in the presence of heterogeneity faces many constraints insofar as the objective of monetary stability is hard to achieve in the presence of this heterogeneity (for example, one decision may suit the macroeconomic evolutions of one country and not be suitable for another).
However, even if the partner countries are unanimous concerning the objectives of the common monetary policy, they face an additional constraint related to the divergence of monetary transmission mechanisms. Indeed, different structures between many economies composing a monetary zone make their reaction (or their response) to a shock diverse. Moreover, the speed of price adjustments differs according to the extent of this diversity. In addition, the delays in monetary transmission are long and inconsistent, and expand according to changes in the financial, economic and institutional environment.

Basically, the common Central Bank can no longer achieve its objective of price stability for the entire zone given the increasing complexity of the transmission mechanisms of monetary policy.
On the other hand, the absence of political unification within Europe makes the situation more difficult. In fact, in spite of a strong political desire to create the unique European currency, the discordance of individual decisions, especially budgetary ones, renders the success of the euro more problematical. Up to now, the feeling of national citizenship has come before the feeling of being European.
The history of monetary unions shows that the failure of the monetary integration process was often due to the absence of efficient adjustment mechanisms allowing the viability of the monetary zone, especially when it is deeply heterogeneous. Bordo & Jonung (1999) consider the theory of optimum currency areas (OCA) as static and ahistorical. They also consider that studies which have dealt with the question of the stability and durability of monetary unions are few. This is why future research into OCAs must be oriented toward the practical questions linked to the relative efficiency of different adjustment mechanisms.
Also, history shows that the absence of political involvement toward the process of monetary integration facilitates the disintegration and the division of countries into many independent entities, each of them characterized by a new national currency and a unique Central Bank (Goodhart, 1995).
In Africa, the decision of African Central Bank governors to adopt a single currency by 2021 and the call from the union of Maghreb banks in November 2007 to create one currency for the Maghreb raises the same doubts as to the efficiency of such decisions.
The Maghreb countries (which groups together Algeria, Libya, Morocco, Mauritania and Tunisia) indeed decided to improve the coordination of their economic policies and to reinforce their financial and commercial relations when they created the Arab Maghreb Union (AMU) in February 1989. The reasoning behind this creation is that a Maghrebian zone where goods, services and capital circulate freely would be an attractive market for domestic and foreign investors. In particular, a well-integrated Maghrebian zone would bring more important advantages then the potential gains resulted from association agreements with the European Union and the new European neighbourhood policy. It would moreover become an attractive destination for other investors notably the oil-exporting countries of the Middle-East (IMF 2007). Besides, the establishment of supranational central bank would resolve the problem of dependence of national central banks.
This ambition to pursue an autonomous monetary policy in order to avoid the marginalisation of their monetary power faces many problems. Indeed, the economic and financial structures of these countries are different and evolve with changes in the international environment. Furthermore, these countries conduct monetary policies whose objectives and strategies are not yet transparent.
Moreover, a political involvement directed towards the creation of a monetary union probably constitutes a serious problem for governments, given the traditional rivalry between some countries of the zone and the importance of the seigneuriage role as a last resort. Furthermore, there are still many political problems which have prevented, until now, the completion of the economic and financial integration within the Maghreb as well as the functioning of the AMU (Darrat & al 2002).
In this work, we have tried to understand the foundations of differences in Maghrebian monetary regimes to evaluate the consequences of the choice of monetary unification in these countries[*].
To this end, we have tried in a first section to describe the evolution of the monetary practices of the Maghreb countries (MC). We have illustrated in a second section the heterogeneity of these practices from a model describing the functioning of their economies. We have finally tried in a

[*] Our sample is limited to Algeria, Morocco and Tunisia.

third section to evaluate the consequences of this heterogeneity by simulating optimal monetary policy rules for each country.
Our choice is focused on the Taylor rule and expresses our willingness to define an efficient, credible and simple rule which will be understandable by all economic agents and will constitute the key to the success of all future reforms undertaken by the Maghrebian authorities.

I-Monetary regimes in Maghreb

McKinnon & Schnabl (2004) admit that emerging markets and developing countries cannot choose their monetary regimes in an exogenous way. These regimes are in fact endogenous and generally determined by interdependent factors such as macroeconomic stabilisation, invoicing of international trade as well as currency denomination of the international capital flows.
In this section, we will try to describe the evolution of monetary regimes (monetary and exchange rate policies) in MC over the last two decades before illustrating the foundations of this evolution via a simple model of an open economy.

I-I-Tunisia

In the early 1980s, the Central Bank of Tunisia (CBT) undertook to define a strategy aiming at the preservation of the value of the currency and the support of the economic policies of the government. However, although this strategy has more than one objective, price stability remains the primary (implicit) objective of monetary policy.
Indeed, since 1987, the Tunisian monetary authorities have had as an intermediary objective the targeting of M2 aggregate. This is determined according to the quantitative function MV=PY. In fact, the CBT fix a growth of M2 at 2% below the projected growth of nominal GDP[†]. Then, under the assumption of a roughly constant multiplier, the amount of base money supply consistent with the target growth of M2 is calculated. Finally, taking into account projected net international reserves and the credit requirement of the agricultural sector, the CBT determines the quantity of liquidity to be distributed through the refinancing facilities. On a weekly basis, these amounts are fine-tuned taking into account the perceived financing needs of the commercial banks (Treichel 1997). Any deviation of M2 from its reference value is considered as a risk to the price stability objective.
To attain its intermediary objective, the CBT acts on the amount of liquidity. Until 1996, this amount was regulated from the restrictions imposed to the commercial banks. These banks are in fact submitted to constraints such as the obligation to finance priority sectors as well as the fixation of debtors' interest rates.
Furthermore, from 1997, after the removal of these restrictions, the principal instrument became that of money market interventions (FMI 2004). The CBT inject or withdraw liquidity through the refinancing facilities (repurchase agreements and bid techniques[‡]). These techniques are completed with standing facilities and weekly fine-tuned operations in light of the financing needs of the commercial banks. As regards reserve requirement techniques, this was not actively used during the last two decades. In October 1989, the reserve requirement rate rose from zero to 2%. From that date to the early 2000s, banks had to deposit on non remunerated accounts, at the Central Bank, all deposits which were above a certain rate determined monthly by the emission institute.
Since 2003, the CBT has modified the quantitative approach through the targeting of M3 instead of M2. The final aim being to attain an inflation objective close to the one observed in partner and competitive countries. However, in reality, the formulation of the monetary policy has not really changed and the Central Bank has continued to act on the level of banking liquidity

[†] The CBT inserts in the definition of M2 the anticipation of prices, products and the velocity of this aggregate.
[‡] The distinction between the two instruments is a little bit vague. For further details, see Dack (1999).

through many operations, notably call for tender, allowance uptake[§] as well as weekly fine tuned operations. The reserve requirement technique was also reactivated and differentiated according to the duration of deposits in 2002[**].

Moreover, from 2006, the monetary authorities claimed that the fundamental objective of the Central Bank is price stability and that the emission institute will use the interest rate as a basic instrument which, in line with fine regulation, will help it to influence the price level[††].

Practically, the adoption of this new frame will be established in two stages. At the first stage, the Central Bank will apply a quantitative approach by acting on the monetary base (considered as its operational objective) and by using money market operations to regulate bank liquidity. Afterwards, during the second stage, the institute of emission will establish an inflation targeting approach (CBT 2007). This target will be reached through the manipulation of interest rates and will allow it to continue to control prices.

Concerning the exchange policy, the aim of establishing prudent monetary policy following the recession and the balance of payment problems of the middle 1980s – combined with the start of an openness and a liberalization process of the economy – urged the monetary authorities to target the real exchange rate (after having devaluated the dinar).

This policy consists of indexing the nominal exchange rate to the domestic price level in order to cancel the loss of competitiveness of the economy and the overvaluation of the Tunisian dinar. A domestic price shock can in fact be resolved through a depreciation of the nominal exchange rate and rapid monetary growth.

The aim of this strategy is then to keep a constant real exchange rate level (CRER) vis-à-vis the partners through nominal exchange rate adjustments.

More recently (the beginning of 2000s), the monetary authorities have been more flexible in the application of this rule by basing themselves on a series of indicators of competitiveness. This evolution has allowed wider fluctuations in the actual real exchange rate notably successive depreciations (Fanizza & al 2002).

It seems then that monetary authorities sometimes use the nominal exchange rate to correct shocks on domestic prices. Such a practice can lead to hyper inflation[‡‡]. But, in the case of Tunisia, the success of targeting real exchange rate policy was facilitated by the absence of shocks in the terms of trade, the rigidity of prices and wages as well as the continuity in controlling the capital account (Dropsy & Grand 2004).

I-II-Morocco

At the beginning of the 1990s, Bank Al Maghrib (BAM) was led to rely more on a quantitative approach to attain its final goal which was redefined around price stability and the stability of the value of the national currency. Indeed, the objective of monetary rule prompted it to define a growth rate for the monetary aggregate M1[§§] considered as an intermediary objective. The growth rate is estimated at 8,3% to reach a 2% inflation rate (Benbouziane & Benamar 2004).

To achieve their goal, the monetary authorities have adopted a policy of base. Indeed, BAM tried to manipulate the monetary base by putting in place indirect intervention instruments (instead of rediscount techniques) such as 7 days call for tender, 5 days and 24 hours advances, as well as

[§] The 3 months allowance uptake of treasury bonds was introduced in 2001.

[**] It is useful to note that the CBT continue his rising of the reserve requirement rate given the prevailing situation of excess of liquidity of the Tunisian money market (CBT 2007).

[††] Article 33 of the law n°2006-26 of 15 May 2006 modifying the law n°1958-90 of 19 September 1958 relating to the creation and the organization of CBT.

[‡‡] The depreciation of the nominal exchange rate could lead to an increase in the price of foreign goods (and/or a revision in the increase of the inflation expectations concerning the price of domestic goods), which can feed inflationary pressures.

[§§] Until 2006, the aggregate target was M1, but, with the great instability of this aggregate (privatization operations, tourist receipts, foreign workers' remittances), the Central Bank chose M3 aggregate.

reserve requirement operations. The latter were used consistently at the beginning of the financial liberalization process (early 1990s).

On the contrary, the constraints imposed on the asset side of the banks were gradually softened down and finally disappeared completely. For example, the public bill floor was abrogated in 1998 and the coefficient of compulsory uses was also eliminated in April 1994 (Sagou 2006).

During the last few years, notably in the early 2000s, the Moroccan money market has been characterized by an excess of banking liquidity[***]. This situation has influenced the functioning of the money market and the conduct of the monetary policy of BAM. So, the operational framework has been renewed. The Central Bank indeed tries to intervene on the interbank market in order to insure the refinancing of the banks while reaching a desired level of "from day to day" rate. This rate has to fluctuate between a floor rate (interest rate applied to the 24 hours deposit facilities) and a ceiling rate (interest rate applied to 24 hours advances). Such a framework allows the Central Bank to manage liquidity and to point out the general short and middle term orientation of monetary policy.

It follows that the modification of banking liquidity is made through quantities and the level of intervention rate is stable and rarely revised. Basically, the instruments used to that end are essentially liquidity injection canals (7 days advances via weekly call for tender and 24 hours advance facilities at the initiative of banks) as well as liquidity tapping channels (weekly resumption liquidity operations at the initiative of the Central Bank and 24 hours deposit facilities at the initiative of banks). These techniques are completed with secondary instruments such as fine tuned operations (temporary selling or purchasing of treasury bonds, firm operations or foreign exchange swaps) and reserve requirement operations.

But, with the persistence of the excess of liquidity, notably since 2003, the liquidity tapping operations have become almost the only usual technique used by the Central Bank. Indeed, this institution has become constantly concerned with the sterilisation of the superfluous "over liquidity" through the sale of securities on the money market. It also raised the rate on 7 days tapping liquidity operations from 2.5 % to 2.75 % in December 2006.

Therefore, the operational frame of the Central Bank of these last few years has not worked well, since BAM intervened, via their leading rates[†††] only to counter excess liquidity instead of conducting an efficient monetary policy.

Nowadays, the Moroccan monetary policy continues to benefit from a certain autonomy given the limitations imposed on the financial account (in particular the exit of capital), which allowed the convergence of the inflation rate towards those of developed countries. The final goal of the monetary policy is always to guarantee price stability but via a multicriteria approach[‡‡‡]. Efforts are made to forecast inflationary pressures within the framework of a strategy aiming at the establishment of inflation targeting regime.

As regards the exchange policy, it had for objective a gradual real depreciation of the dirham during the period 1980-1985. Combined with dollar appreciation, this policy led to a depreciation of the real exchange rate of about 84%.

Moreover, the 1990s knew the accentuation of the liberalization movement of the economy and the stimulation of the exchange market. Monetary authorities continued over this same period a careful monetary policy having for objective the stabilization of the exchange rate, notably by anchoring the dirham to a basket of currencies, the composition of which is kept secret. However, the real exchange rate was appreciated in relation to the other currencies following a

[***] This excess of liquidity was often attributed to the increase of net outside assets of Central Bank due to selling of 35% of the capital of Maroc Télécom, favourable increase of tourist receipts as well as increase of foreign workers remittances.

[†††] They are call for tender, facility of deposit and facility of lending rates.

[‡‡‡] For further details, see BAM (2007).

rise of the dollar which forms a significant part of the basket but also because of a downward rigidity of prices and wages (Jbili & Kramarenko 2003).
It is important to note at this point that the lack of competitiveness of Moroccan products should have urged the authorities to devalue the currency several years ago. However, these authorities have instead concentrated their efforts on the consolidation of the financial system and the lowering of the burden of the debt. It was necessary to wait until 2001 to see the authorities devalue de facto the dirham by 5 % (Bouoiyour & al 2004).
Furthermore, the increasing integration of the Moroccan economy into the world economy of these last few years, in particular into the European one, has incited the Moroccan Central Bank to adjust the basket by giving bigger weight to the euro in 2001[§§§]. The objective was to keep inflation under control and to preserve the external competitiveness of the Moroccan economy.
The terrorist attacks of 2003 had an immediate impact on the value of the dirham which depreciated. At the same time, the exchange office announced an increase of the trade deficit due to an increase of petroleum imports and a slowing of exports, what created disturbances on the exchange market.
However, the IMF and the Moroccan monetary authorities consider that the actual real exchange rate does not reveal an important gap with regard to the fundamentals and that the anchoring of the dirham to a basket of currencies has contributed to macroeconomic stability and inflation control. In return, despite this stability, growth remains low and reflects the dependence of the country on its agricultural sector and raw material resources (notably phosphate) as well as the slowness of structural reforms.

I-III-Algeria

The institution of the credit and money law in the early 1990s led to a shift in the banking and monetary fields of the Algerian economy. The Central Bank, unlike in the years before, was henceforth able to define monetary policy, prudential rules and the regulation of macroeconomic activity.
In reality, over the period 1990-1993, the monetary policy was an accommodating policy trying to satisfy the financing needs of banks and the public sector in a difficult economic context characterized by a stagflation[****]. No priority in monetary policy objectives was defined and the risk of conflict between the objectives of price and activity was very real.
Besides, this same law of the early 1990s set up a package of indirect instruments such as rediscount, allowance uptake of private and public bills, open market operations as well as reserve requirement. However, in reality, given the prevalent situation at the time, instrumentation was direct. The interest rates could not really play their role in the allowance of resources given the weak situation of public companies and the high level of inflation, making them negative in real terms.
It was with the enforcement of the macroeconomic stabilization program (1994-1995) followed by the structural adjustment program (1995-1998) that monetary policy was really able to play its role. Indeed, on the eve of the coming into force of the stabilization program, the governor of Bank of Algeria (BA) signed instruction n°16-94 of April 1994 concerning the instruments of monetary policy and the refinancing of banks. The final objective of monetary policy was inflation control[††††], but also the activity growth (at a secondary degree)[‡‡‡‡].

[§§§] Besides, Mussa et al (2000) consider that the anchoring to a basket of money which represents the main trading partners remains better than close money anchoring.
[****] This stagflation was the result of a historical fall of hydrocarbon prices of the middle 1980s and a deterioration of the socio-political situation in the early 1990s.
[††††] It was more a question of cancelling the inflationary drift due to important adjustment of the dinar exchange rate combined to a liberalization of many prices (Ilmane 2006).
[‡‡‡‡] The consideration of the activity objective is reflected by the fact that the inflation target which the Central Bank have to control is defined in compatibility with a certain growth rate of the economy.

To reach this objective, a double intermediary objective was defined, that is the limitation of the money supply and credit growth. However, reaching this double objective required having recourse to a double operational objective consisting in fixing an upper limit to the growth of the Central Bank internal assets (credits to the State and refinancing of banks) as well as those of the banks (credits to the State and to the economy)[§§§§].

As for the instruments used, the Central Bank was led to set up a battery of rates in order to supervise the banking rates and direct its intervention, namely: a rediscount rate set at 15%, an intervention pivot rate over the money market set at 20% and a rate applied to advances to banks set at 24%. But, due to the prevalent economic situation and the incapacity of these instruments to control monetary and credit expansion, other instruments were introduced, notably: a rediscount upper limit by bank, credit restriction, credit auctions[*****] (call for tender) as well as reserve requirement techniques[†††††].

During the structural adjustment period, the monetary policy was assigned the role of fighting inflation which had primacy over a full employment objective. In this context, the inflation rate, after its stabilization during the previous period, had to evolve to a rate comparable to that of the main trade partners. The intermediate objective was the limitation of money supply growth of M2 via the control of Central Bank internal assets. The instruments put in place were those used during the stabilization period but accompanied by the introduction of Treasury bill auction techniques as well as the establishment of open market operations[‡‡‡‡‡].

From 2001, the conduct of the Algerian monetary policy consisted in targeting clearly a rate of inflation as a middle term prospect. Unlike the previous years, this rate was set at 3% (Grand Alger index). The objective was not only to insure price stability but particularly to maintain a low level of prices already reached during the stabilisation and structural adjustment period[§§§§§]. The intermediary objective was money supply (and credit to the economy). In coherence with this objective, BA tries to use a reserve requirement technique –which has been really reactivated– and bank liquidity mapping (Zouache & Ilmane 2008).

Besides, these last few years has been marked by the durability of the abundance of liquidity (because of the prodigious increase in oil receipts), which has allowed the commercial banks to work in an "out of bank" system. This has limited the use of Central Bank monetary policy instruments such as rediscount. At the same time, this situation has forced BA to act in two directions. On the one hand, it offers remuneration to banks for the liquidity which is not used. On the other hand, it subjects these banks to mandatory regulations. Indeed, to mop up the excess of liquidity, BA has intervened on the interbank money market by using resumption liquidity operations with more frequency. These became the main indirect instrument of the monetary policy. Similarly, a further indirect instrument called "remunerated deposit facilities" was introduced at the end of 2005 (Bank of Algeria 2006). Also, in the field of regulation, the base of calculus of reserve requirements was increased to 6.5% of deposits in dinars.

As regards the exchange policy, after anchoring the dinar to a basket of currencies, the petroleum counter shock and the term of trade deterioration during the second half of the 1980s forced the monetary authorities to let the Algerian dinar depreciate against the other currencies. During all the period of depreciation (from the middle 1980s to 1995), the parallel market developed and the black market exchange rate reflected better the economic reality.

[§§§§] According to Ilmane (2006), the real operational objective which BA could master in that time was its « internal assets » post.

[*****] This technique was used at the same time as rediscount, but within the limits of the fixed ceilings.

[†††††] This instrument was effectively used from 2001.

[‡‡‡‡‡] These operations were used solely two times during the second half of 1990s.

[§§§§§] The objective of stabilization was not excluded but BA took the political liberty by only taking care for price stability as final objective of monetary policy.

Faced with this situation, Algerian authorities took as a guideline the stability of the dinar. Indeed, since 1995, the Algerian exchange rate policy has tried to maintain a stable real exchange rate against a basket of currencies including the main trading and competing countries. The monetary authorities tried to apply in this framework a managed float with no predetermined path. BA intervenes on the exchange market to periodically re-align the nominal exchange rate to honour its objective of real effective exchange rate (REER).

Between 1995 and 1998, the REER appreciated[******]. Until 2001, it depreciated with regard to the euro because of the appreciation of the European currency against the dollar. The authorities intervened on the exchange market in 2003 to align the REER with its level of 2002 rather than that of 1995 (Koranchelian 2005). It has remained relatively stable over these last four years and close to the equilibrium value (IMF 2006). The difference between the official rate and the parallel one disappeared in 2006 and expressed the willingness of the authorities to fight against illicit operations.

In practice, BA influences considerably the nominal exchange rate on the official market to attain its objective of real exchange rate. It acts as a seller of foreign currencies, which allows it to influence the orientation of prices and realign the nominal exchange rate: it feeds the market with necessary foreign currencies and reduces the excess of liquidity whenever necessary. This facility of intervention over the exchange market may be explained by its capacity to manipulate the counterparts of most exchange transactions. This manipulation is the result of three factors[††††††]: the primacy of hydrocarbon exports in total exports (more than 95%), the obligation of conversion in dinar (to the Central Bank) of hydrocarbon export receipts as well as the continuity on controlling the capital account.

To conclude, one can notice that, although the monetary policies of MC have similar final objectives, the operational frames and the monetary instruments used for the realization of these objectives differ from one country to another. Also, the exchange rate policies of these countries are led and interpreted differently.

A question arises at this level: can one illustrate this heterogeneity of Maghreb? It is the object of the following section.

II-Illustration of the heterogeneity of Maghreb Countries[‡‡‡‡‡‡]

II-I-The model

Our method tries to detect the heterogeneity of MC. It consists firstly of estimating a model characterising the economy of each country. Once the model is estimated, we should define the most effective rule. To do so, it is essential to define a loss function which the Central Bank tries to minimise[§§§§§§].

Our model is that of an open economy. It contains an IS equation (supply and demand over goods and services market), a Philips curve equation (inflation-unemployment trade-off) and an exchange rate equation (exchange behaviour) for each country.

This model is estimated on the basis of quarterly data over the period 1990, 2006[*******]. These data are extracted from the IMF database (International Financial Statistics) and DATASTREAM. The three equations are as follows:

[******] This appreciation coincides with the structural adjustment period and may be due to productivity growth and administrative price adjustments (Sorsa 1999).

[††††††] Koranchelian T (2004): The Equilibrium Real Exchange Rate in a Commodity Exporting Country: Algeria's experience » IMF Working Paper n°135, July.

[‡‡‡‡‡‡] Many empirical studies have tried to explain the heterogeneity of a zone by putting in place a series of macroeconomic variables. For a survey, see Penot (2002).

[§§§§§§] This methodology was adopted in many works such as Durand & Payelle (1998), Freedman (1981), McCallum (1994), Penot & al (2001), Penot & Pollin (1999) …

[*******] The choice of this period is imposed by the fact that, in these countries, the liberalization process started only in the early 1990s.

$$y_t = A(L)y_t - B(L)e_t - C(L)[i_t - \pi_t] + \eta_t$$

$$\pi_t = D(L)\pi_t - E(L)e_t + F(L)y_t + \varepsilon_t$$

$$e_t = G(L)e_t + H(L)\pi_t + K(L)y_t + \nu_t$$

Where y, π, i and e are respectively the growth rate of industrial production index (IPI), the growth rate of consumption price index (CPI), nominal interest rate (the instrument of monetary policy) and REER in each country[†††††††].
$A(L), B(L), C(L), D(L), E(L), F(L), G(L), H(L)$ and $K(L)$ are the traditional polynomial lags of which the degrees are naturally different from one country to another according to the significance of the estimated coefficients. η, ε and ν are error terms.

The first equation shows the effect of monetary and exchange rate policy on the activity and therefore on the real sphere. An appreciation (depreciation) of the exchange rate implies a price increase (a price fall) of the domestic goods comparing to the foreign ones which leads to a decrease (increase) in domestic production. Also, a restrictive (expansionist) monetary policy reflected by an increase (decrease) in interest rate acts negatively (positively) on the global demand component and leads to a decrease (increase) in domestic production. The expected coefficients for e and $(i_t - \pi_t)$ are then negative.
The second equation shows how economic growth and exchange policy affect prices[‡‡‡‡‡‡‡]. An appreciation (depreciation) of exchange rate makes domestic products less required (more required) and decreases (increases) the inflationary pressures while a rapid (sluggish) economic growth due to expansionist (restrictive) monetary policy for example leads to an acceleration (deceleration) of inflationary pressures[§§§§§§§]. This argument is often stated by central bankers when they claims that demand increase more rapidly then supply. The expected coefficient for e is then negative while that of y is positive.
Finally, the third equation shows how evolution of inflation and activity acts on the exchange rate. Higher (lower) inflation leads to an appreciation (depreciation) of the real exchange rate following a price increase (decrease) of domestic goods – more (less) than foreign one – while low (high) activity growth leads to the reverse effect (same effect). The expected coefficients for π and y are then positive.

One can note at this level that we can find in these equations the different sources of difference between countries. Indeed, the growth rate equation (the first equation) describes how exchange rate and monetary policy can influence the dynamism of the economy. The effect of exchange policy on economic growth depends for example on the degree of openness of the countries and shows in fact the diversity of economic structures. Similarly, the effect of monetary policy on economic growth depends for example on the sharing of direct finance versus indirect finance and shows therefore the differences in financial structures.

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††††††† The REER is defined as follows: $REER = P^D \,/\, P^F * NEER$ (P^D are the price of domestic goods and P^F the price of foreign goods). An increase in REER is synonymous with appreciation.
‡‡‡‡‡‡‡ We consider that the hypothesis of Stock and Watson (1999) is verified (the potential economic activity is constant over the short term period) and that the activity, rather then the output gap, affect the inflation.
§§§§§§§ It is the effect of imported inflation in an opened economy.

Moreover, the second equation shows the effect of growth and exchange rate on inflation and exemplifies the differences in productive and institutional structures. In an open economy for example, the effect of growth on inflation is more important than in a closed one. Besides, rigid labour markets may lead to a permanent effect of economic growth on inflation. Likewise, the effect of exchange rate variations on inflation depends for example on the market power of local participants – and so on the degree of competition – as well as the "pricing to market behaviour" and reflects the differences in productive structures. This effect may also depend on the willingness of monetary authorities to maintain their price stability objectives and reflect then differences in the credibility and the effectiveness of the monetary policy (Taylor 2000).
Finally, the third equation shows the effect of growth and inflation on the exchange rate and expresses for example the differences of labour market functioning. It may also express the characteristics of the economy (case of rental economy).
The effect of inflation on the exchange rate for example is minor if prices and wages are flexible. Similarly, the effect of economic growth on the appreciation of exchange rate is big if prices and salaries do not adjust rapidly or if the economy is based on a unique sector.

II-II-Estimation of the model

Before estimating the parameters of the model, we established a Phillips-Perron stationarity test for the different variables to avoid a spurious regression. Table 1 synthesizes our results (see appendix).

It transpires then from this table that for all countries, the two non stationary variables are the real exchange rate and the real interest rate I (1) while the growth rate of IPI and ICI are stationary I (0).

We then established a Johansen (1991) co-integration test about the relevant variables. Table 2 shows our results (see appendix).
It turns out that in the case of three countries and for equation (1), the two variables (real money rate and real exchange rate) are not co-integrated. The regression is therefore made by using the first difference of the two variables. For equation (2), the co-integration problem does not arise (except that the regression is made by using the first difference of the real exchange rate). Similarly, for equation (3), the problem does not arise and the regression is simple (and not in difference)[********].

The next step consists in the search for the optimal lags based on information criteria: Akaike (aic) and Schwartz (bic)[††††††††]. Our results are shown in table 3 (see appendix).
We notice from this table that the majority of lags vary between countries, meaning that, the effects of monetary and exchange rate policies on activity and prices take different lapses from one country to another (equation 1 and 2). Similarly, the effects of activity and price evolution on the exchange rate are different (equation 3)[‡‡‡‡‡‡‡‡].
Indeed, the optimal lags of the first equation show that the effects of monetary policy on the real sphere ($C(L)$) appear after two quarters for Tunisia and one quarter for Morocco and Algeria. This result may express the resemblance of the sharing direct/indirect financing in these countries. Besides, despite many efforts aiming at developing the capital markets, indirect financing remains the pillar in financing the economies of MC and financial markets still remain

[********] Hassler (1996): « Spurious regression when stationary regressors are included » Economic letters 50 p25-31.
[††††††††] Generally, lag length criteria such as Akaike and Schwartz statistic are not without shortcomings and should be used more as a guide than as uncompromised rules.
[‡‡‡‡‡‡‡‡] However, these results and the interpretations which follow remain dependent on the degree of significance of the estimated parameters (see below).

superficial. However, the financial specificities of each country make the extent of monetary policy transmission different (see below).

As for the effects of exchange policy ($B(L)$), they appear after one quarter for Tunisia and Morocco and two quarters for Algeria. A variation in real exchange rate will have an immediate effect in the Tunisian and Moroccan economies with regard to the Algerian one. This last result can be expected especially because these economies are open. It can also explain the flexibility of Tunisian monetary authorities in the treatment of the real exchange rate target rule.

Concerning the lags of the second equation, the results show that the final effects of economic growth on prices ($F(L)$) appear after two quarters for Tunisia and Morocco and three quarters for Algeria. Accelerated economic growth for example in these countries does not entail an immediate effect on prices (even if these economies are opened). This result may be due to the rigidity of labour markets. Indeed, the speed of renovation efforts in these markets remains modest and the pace of wage adjustment is still slow.

As for the effects of the exchange policy on prices ($E(L)$), they appear after one quarter for Tunisia and Algeria and three quarters for Morocco. This result allow to mention that an appreciation of the real exchange rate for example may have an immediate effect on inflation in the first two countries, and can probably reflect the importance of efforts of openness in these economies. This may strengthens the idea of the importance of the "pass through" effect of exchange rates in an open economy. It may also corroborate the idea according to which, although the Moroccan economy is opened, quasi-fixed exchange rates can delay the effect of exchange rates on prices.

Finally, for the lags of third equation, the table shows that the effects of inflation on exchange rates ($H(L)$) appear after five quarters in Tunisia, three quarters in Morocco and one quarter in Algeria. Inflation affects immediately the Algerian exchange rate while the effect is not immediate in Tunisia and Morocco. This result can reflect the structure of the Algerian economy where dependence on one sector renders the exchange rate more sensitive to the variation of foreign good prices.

As regards the effects of activity on the exchange rate ($K(L)$), they appear after two quarters in Tunisia and one quarter in Morocco and Algeria. Accelerated economic growth for example may have an immediate effect on the exchange rate in the last two countries while the effect is more delayed in the Tunisian case. This confirms the idea that wages and prices do not adjust quickly in these economies.

Finally, the estimation of our model has allowed us to reach the following results[§§§§§§§§] :

For Tunisia:

$$y_t = 0{,}01557 + 0{,}41561 y_{t-4} - 0{,}00507 \Delta e_{t-1} - 0{,}01408(\Delta i_{t-2} - \Delta \pi_{t-2}) + \eta_t^{Tun}$$

$$(2.51)^{***} \quad (3.35)^{***} \quad (-1{,}66)^{*} \quad (-1.76)^{*}$$

$$DW = 1{,}846 \qquad \overline{R}^2 = 0{,}4012$$

[§§§§§§§§] Non significant coefficients are not transferred here, unless they are about one lag.

*** Significant at the 1% level. ***significant at the 5% level. *significant at the 10% level.

$$\pi_t = 0.00555 + 0{,}35104\pi_{t-1} - 0{,}00044\Delta e_{t-1} + 0{,}03494 y_{t-1} + 0{,}04 y_{t-2} + \varepsilon_t^{Tun}$$
$$(3.13)^{***}\ (2.5)^{**}\qquad (-1.06)^{*}\qquad (2.59)^{**}\qquad (1.84)^{*}$$
$$DW = 2{,}005 \qquad \overline{R}^2 = 0{,}1219$$

$$e_t = -3.32712 + 1{,}036 e_{t-1} - 5.20482\pi_{t-5} + 6{,}12838 y_{t-2} + \nu_t^{Tun}$$
$$(-1.16)^{*}\ (34.25)^{***}\ (-2.07)^{**}\qquad (1.53)^{*}$$
$$DW = 2.021 \qquad \overline{R}^2 = 0{,}9531$$

For Morocco:

$$y_t = 0{,}02203 - 0{,}53969 y_{t-1} + 0{,}49101 y_{t-4} + 0{,}00088\Delta e_{t-1} - 0{,}005(\Delta i_{t-1} - \Delta\pi_{t-1}) + \eta_t^{Mor}$$
$$(3.42)^{***}(-4.47)^{***}(3.88)^{***}\qquad (0.32)^{*}\qquad (-1.94)^{*}$$
$$DW = 1.961 \qquad \overline{R}^2 = 0{,}9296$$

$$\pi_t = 0.00276 + 0{,}12584\pi_{t-1} + 0{,}68989\pi_{t-3} - 0{,}00513\Delta e_{t-3} - 0{,}04566 y_{t-1} + 0{,}03512 y_{t-2} + \varepsilon_t^{Mor}$$
$$(1.31)^{*}\quad (1.93)^{**}\qquad (4.63)^{***}\quad (-4.07)^{***}\qquad (-2.42)^{***}\quad (1.96)^{**}$$
$$DW = 2{,}059 \qquad \overline{R}^2 = 0{,}3733$$

$$e_t = 9.30842 + 1{,}86477 e_{t-1} + 0{,}467 e_{t-4} + 4.4703\pi_{t-3} - 1{,}853 y_{t-1} + \upsilon_t^{Mor}$$
$$(2.49)^{**}\ (11.19)^{***}\ (2.53)^{**}\quad (2.43)^{**}\qquad (7.06)^{***}$$
$$DW = 1.603 \qquad \overline{R}^2 = 0{,}9074$$

For Algeria:

$$y_t = 0.00736 - 1{,}02928 y_{t-1} - 0{,}69344 y_{t-2} - 0{,}51546 y_{t-3} - 0{,}00091\Delta e_{t-2} - 0{,}00115(\Delta i_{t-1} - \Delta\pi_{t-1}) + \eta_t^{Alg}$$
$$(1.94)^{*}\ (-12.25)^{***}\ (-6.11)^{***}\ (-6.14)^{***}\ (-2.54)^{**}\qquad (-1{,}47)^{*}$$
$$DW = 2.064 \qquad \overline{R}^2 = 0{,}679$$

$$\pi_t = 0.01397 + 0{,}20230\,\pi_{t-2} - 0{,}00039\,\Delta e_{t-1} - 0{,}39761\, y_{t-2} - 0{,}36534\, y_{t-3} + \varepsilon_t^{Alg}$$
$$(2.47)^{**}\ (2.05)^{*}\qquad (-0{,}62)^{*}\qquad (-2.53)^{**}\quad (-3.07)^{***}$$
$$DW = 1.988 \qquad \overline{R}^2 = 0.0575$$

$$e_t = 26.7196 + 0.72405 e_{t-1} + 4.41155\pi_{t-1} - 19.132 y_{t-1} + \upsilon_t^{Alg}$$
$$(5.81)^{***}(16.44)^{***}\ (3.08)^{***}\qquad (-1{,}6)^{*}$$
$$DW = 1.913 \qquad \overline{R}^2 = 0{,}7079$$

These results show that the most important coefficient is not the same and strengthen the idea of the heterogeneity of MC. Indeed, the extent of different policies conducted by monetary authorities on activity, inflation and exchange rate is different and sometime divergent. Concerning the extent of monetary policy on the real sphere, while it is modest, it appears more important in the Tunisian case than in that of Morocco or Algeria. This result may express the specificities of the Tunisian financial structure which can expose it to more interest rate variation. The small size of Tunisian banks and companies, the small availability of capital direct contributions and the short-term debts of Tunisian companies and households are perfect illustrations. However, the existence of bank liquidity excess in Morocco and Algeria can explain the weak capacity of monetary authorities in managing money market operations and so, in influencing banking conditions. The money and credit channels turn out to be less functional in Morocco and Algeria than in Tunisia[*********].
Similarly, the effect of exchange policy on activity is relatively more important in the Tunisian case than in that of Algeria and may express the importance of the degree of openness in influencing the activity. Indeed, the Tunisian economy is more open than the Algerian one (98% in Tunisia against 83,1% in Algeria in 2006) and may reveal the relative importance of exchange rate channels in this country. However, the low sensitivity of the activity to exchange rate modification in the three countries seems to relativize this fact.
Yet, it is useful to mention that the « contradictory effect » of exchange policy on Moroccan activity may be explained by the fact that a great part of Moroccan debt is labelled in foreign currency, by the effects of imported inflation as well as the effects of the increase in petroleum bill (Boughrara 2003).

Concerning the effect of activity growth on inflation, it turns out to be similar in the case of Tunisia and Morocco. Accelerated economic growth for example is translated by an increase in the inflation level, but the effect appears after two quarters. This can reflect the fact that in an open country, the effect of growth on inflation is more important than in a closed one. However, as was explained earlier, the rigidity of the labour market can delay this effect[†††††††††].
It is moreover important to note in this frame that the weakness of the adjustment process in these economies may express price inertia. This inertia may be explained by the still important presence of the public sector in the economy, low competition between sectors but also the presence of industry characterised by sticky prices.
However, the inverse effect occurs in Algeria. Accelerated growth in this country may result in a decline of prices while this decline is felt from the second quarter. This result can reflect the importance of tradable good prices in the Algerian economy. These prices are generally on a par with world prices following acceleration or deceleration of tradable goods production sector[‡‡‡‡‡‡‡‡‡].
In return, the effect of exchange policy on inflation turns out to be small in the three countries, although their economies are open. This effect seems to be the result of continuity in controlling capital movements and the absence of total convertibility of the currency. Moreover, as Engel (2002) noted, in a country where the market power of local participants is important, variations

[*********] However, a detailed analysis concerning the respective position of intermediation and markets, interest rate indexation practices, share of short term credits compared to the long term... in the Maghreb will be interesting in this frame.
[†††††††††] Furthermore, investigation fields concerning the functioning of the Maghrebian labour market, such as the nature of wage negotiation, legal setting, active and passive employment policies, are important in this frame.
[‡‡‡‡‡‡‡‡‡] It is useful to note that the weakness of this effect in the case of Algeria may also translate the bad representation of the total production by the industrial production. This bad representation can be attributed to a weak industrialization of this country.

in the exchange rate do not hardly affect domestic prices. Besides, a good proportion of prices is still administered by the governments of these countries reflecting the firmness in establishing price stability.
This result can also reflect the nominal rigidities and slow adjustment of good prices which could make domestic prices less responsive to exchange rate movements.
Finally, concerning the effects of growth on the exchange rate, they are important for the Tunisian case while the reverse happen in Algerian and Moroccan one[§§§§§§§§§]. The effect of economic growth on exchange rate appreciation is important in Tunisia and can reflect the slowness of wage and price adjustment in this country.
As for the Algerian and Moroccan results, it can be explained by the nature of production in these two countries. A rapid growth in agricultural products for example, which represent an important part of Moroccan economy, may lead to a decrease in prices and then to a depreciation of the exchange rate.
However, results concerning the effects of inflation on the exchange rate show that these effects are acute in Morocco and Algeria but differs from what is expected in the case of Tunisia. The acceleration of inflation in this last country will be translated by a depreciation of the real exchange rate at the end of the fifth quarter. This result can express a progressive substitution of domestic goods by foreign ones following an increase in the price of the former. Final result may be so an increase in the price of the latter[*********].

Differences between countries appear therefore partially in the estimation of the model, but they can be strengthened by the observation of more efficient Taylor rules defined at each country's level.
We would try therefore to answer the following question: which will be the characteristics of the monetary practices in MC?

III-Heterogeneity of the Maghreb Countries: the optimisation results

After estimating the model for each country, our aim is to determine the monetary rules which best fulfil the objective of the Central Bank, that is, to minimise a loss function[††††††††††]. We retain the Taylor rule in an open economy which the simple form is as follows[‡‡‡‡‡‡‡‡‡‡] :

$$i_t = \phi i_{t-1} + \alpha(y_t - y^*) + \beta(\prod_t - \prod^*) + \delta(e_t - e^*)$$

Where α , β and δ are respectively the weight attached to activity, inflation and exchange rate by the Central Bank[§§§§§§§§§§]. Moreover, the existence of the term i_{t-1} expresses the interest rate

[§§§§§§§§§] This result joins many works which mention the absence of Balassa-Samuelson effect, especially in the case of Algeria.
[*********] This result can also reflect the flexibility of Tunisian monetary authorities in the application of real exchange rate target rules. Inflation is corrected by a more important nominal devaluation, which finally leads to a depreciation of the real exchange rate.
[††††††††††] The form of this loss function is :
$E(L_t) = E(\prod_t - \prod^*)^2 + \lambda E(y_t - y^*)^2 + \psi E(e_t - e^*)^2 + \phi E(i_t - i_{t-1})^2$. We suppose that each element in the loss function is identically weighted, which means that $\lambda = \psi = \phi = 1$. This function express the willingness of the monetary authorities to reduce inflation fluctuations, output gap and exchange rate variations in accordance with their objectives. The existence of interest rate in the loss function is justified by the fact that most efficient rules in term of activity stabilisation and inflation control generate very high interest rate variations. For further details on the shape of the loss function in a closed economy, see Penot & al (2001), Woodford (2001).
[‡‡‡‡‡‡‡‡‡‡] This rule displayed many improvements such as the incorporation of targeted variables in the form of expected inflation.

smoothing behaviour of the emission institute (or the monetary policy inertia). Moving the policy rate by small steps in the same direction increases its impact on the long term interest rate because market participant expect the change to continue and hence price their expectations into forward rates (Mohanty & Klau 2004). Such practice is also often present, especially in countries where banking and financial weakness is significant. It also expresses the willingness to maintain the credibility of the Central Bank and the reduction of uncertainty that mark the key parameters of the structure of the economy. These parameters govern the transmission mechanisms of monetary policy. Lastly, $(y_t - y^*)$represent the output gap or the difference between current production and potential production, $(\prod_t - \prod^*)$is the deviation of inflation from its target value and $(e_t - e^*)$ is the deviation of current exchange rate from its equilibrium level. However, given that several studies showed that in the three countries, there were no problems of substantial alignment and there were no important pressures with regards the exchange rate, we replace the expression $(e_t - e^*)$with the real effective exchange rate variation$(e_t - e_{t-1})$[**********].

The presence of this last term shows that the Central Bank can also act, alongside inflation and output variations, in exchange rate deviations in order to maintain its objective of price stability but also to guarantee financial stability, which reinforces the "fear of floating" hypothesis (Mohanty & Klau 2004).

Generally, the presence of the output gap and the exchange rate variation in the Central Bank rule expresses the concern of this institute regarding the lack of a price stability announced objective. This case often applies for small opened economies where an excessive variation of activity or exchange rate considerably affects the inflation rate.

As such, the Taylor rule expresses the behaviour of the Central Bank in setting the interest rate which follows a change in correspondent variables. In general, the Central Bank raise their interest rates when the output gap increases (situation where current production is far from potential production), the inflation gap deepens (situation where current inflation is far from its target value) and also when the exchange rate gap increases (situation where e increase comparing to e_{t-1}).

It follows that, once our model is estimated, the residual which are considered to be the shocks affecting the economy, are recovered. These last ones respect the distribution of historical shocks. It is then a matter of historical simulations which deal with reproducing the past shocks.

Our objective consists so of observing the behaviour of monetary authorities following a shock hitting the economy. For that purpose, we use for each country a model with four equations: the first three describe the functioning of the economy (the model above) while the last one is the Taylor rule. We look through this rule for the parameters α, β, δ in the interval [0.1:10.1] by choosing a step of 0.1 and by repeating 250 times. We hold the value of the coefficients which corresponds to the minimal loss function[††††††††††].

To do so, we suppose that the money market rate (MMR) is the instrument of monetary policy while several Central Banks (including the Maghrebian one) have not until now developed an official policy rate. Moreover, most banking rates are indexed in MMR, which reinforces our choice. We further suppose that ϕ=1 in the three countries since – as mentioned above – the Central Banks have to gain in maintaining financial stability and reducing uncertainty by controlling interest rate volatility. Finally, we consider that the potential growth rate over the

§§§§§§§§§§ The price of financial securities is not taken into account here. We consider that the quasi absence of financial market role in these economies make monetary policy inactive toward a shift in price assets.

********** We consider that the fact of integrating the exchange rate in the Central Bank rule may be useful. However, this hypothesis must be approached cautiously.

†††††††††† This methodology is subject to Lucas criticism.

period 1990-2006 is 5.5% for Tunisia, 5% for morocco and 4% for Algeria while the inflation target over the same period is 3% for Tunisia, 2.8% for Morocco and 3% for Algeria‡‡‡‡‡‡‡‡‡‡.

The final results of our optimisation are reported in table 4§§§§§§§§§§ (see appendix).
It follows that the optimal Taylor rule for each country can be described as follows:

For Tunisia: $\Delta i_t = 4.6(y_t - y^*) + 6.0(\prod_t - \prod^*) + 0.1(e_t - e_{t-1})$
For Morocco: $\Delta i_t = 1.1(y_t - y^*) + 1.1(\prod_t - \prod^*) + 1.1(e_t - e_{t-1})$
For Algeria: $\Delta i_t = 1.6(y_t - y^*) + 1.1(\prod_t - \prod^*) + 0.1(e_t - e_{t-1})$

We notice that the coefficients of each Taylor rules are not the same (except for the exchange rate)********** . The CBT has to grant more important weight to inflation. The activity objective has to be taken into account but to a lesser extent. Indeed, in the hypothesis where inflation will be on its target value, an increase of a half point in prices will necessitate an increase in interest rate by a 3%. Similarly, when the production corresponds at its potential value, an increase of a half point in activity will necessitate an increase in interest rate by 2.3%.
This result may reflect the existence of other instruments which are oriented toward the stabilization of the activity, notably budgetary and fiscal policy, and may explain the least importance of the weight of the activity with regards to inflation in the Tunisian Central Bank function.

As for the Moroccan authorities, they have to grant similar weight to inflation, activity and exchange rate. Indeed, in the case where inflation is at its target value or production corresponds to its potential value or the exchange rate corresponds to its past value, an increase of a half point in prices or activity or exchange rate will necessitate an increase in interest rates by 0.55%.
This similarity may translate the importance of activity variation on prices and consolidates the idea that the Moroccan economy is weak. It is subject to the effects of climate changes as well as socio-political instability. Also, the same importance of exchange rate variation effects on prices clearly explains their existence in the Central Bank rule and can be expected as far as the Moroccan authorities foresee to adopt inflation targeting.

Finally, BA has to grant more weight to activity rather than inflation or exchange rate. Indeed, when the production corresponds to its potential value, an increase of a half point in activity will necessitate an increase in interest rate by 0.8%. In return, in the hypothesis where inflation will be on its target value, an increase of a half point in prices will necessitate an increase in interest rate by 0.55%.
This result may reflect the behaviour of Central Banks in transition economies (from centralized to more liberalized) that partly accommodate non monetary pressures on prices in order to reduce costs in terms of output. It may also reflect the willingness of the monetary authorities to absorb the demand shock provoked by expansionist fiscal policies. The dependence of Algerian budgetary policy vis-à-vis petroleum receipts could lead to demand shock and will render the monetary authorities' reaction more aggressive vis-à-vis the stabilization of the activity.

‡‡‡‡‡‡‡‡‡‡ These numbers are approximate but close to the authorities' statements. See also the IMF and European Commission reports.
§§§§§§§§§§ These results can be confronted with two types of instabilities: on the one hand, because weight assigned to inflation, activity and exchange rate changed during the period of estimation and on the other hand because the reaction function of the central bank is « backward looking » and is not simulated according to expected variables (refer to Lucas criticism 1976).
********** It is interesting to reconsider the results by taking a Taylor rule on which the exchange rate does not figure.

Likewise, for small open economies where the excessive variation of activity considerably affects prices, the Central Bank must grant more important weight to the activity in order to respect its announced inflation objective.

After all, we notice that the Central Banks of the three countries will not have to attach similar weight to inflation and activity objective. The reaction of the latter at an inflation deviation for example differs from one country to another. Also, the primacy of the reaction to the inflation objective compared to the activity objective differs (primacy of the inflation for Tunisia and activity for Algeria).
However, the weight of the exchange rate is relatively weak compared to the others objectives (especially in Tunisia and Algeria). The Central Banks of these countries do indeed have others means of controlling this variable other than the interest rate. These banks often use the control of capital account, foreign exchange swaps… in order to stabilize the exchange rate expectations.
In the same vein, the small reaction of monetary policy for exchange rate variations may reflect the nature of the shocks hitting the economy (Mohanty & Klau 2004). Indeed, according to Taylor (2002), if the exchange rate varies due to temporary disturbances, the interest rate should remain unchanged because such exchange rate movements do not have much effect on expectations of inflation.
In our case, the non reactivity of the Maghrebian Central Banks to this variable (exchange rate) shows that shocks are often temporary. This hypothesis seems to be consolidated in several works that show that Maghrebian exchange rates are near their equilibrium value.

These results strongly support the idea that the Maghreb zone is heterogeneous and that this heterogeneity is the result of differences in productive, financial and institutional structure. It follows thus that, problems are likely to emerge if these countries decide to belong to a monetary union with a common conducted monetary policy. This would likely prove a hindrance for all the countries and would create important costs as far as heterogeneity persist[††††††††††††].

Conclusion and policy recommendations

Starting from the idea that the European experience offers several lessons for countries looking to reinforce their financial and economic integration, this work allowed us to highlight the heterogeneity of MC and the difficulties of establishing a common monetary policy.
We have described first of all the characteristics of monetary and exchange rate policies in the three countries and explained their foundations. We then illustrated this heterogeneity from a simple model reflecting the characteristics of each country. It turned out that the extent of economic policies (monetary and exchange rate policy) on real variables differs between MC.
We then simulated national Taylor rules for each country. Our results suggest that the latter will not choose identical monetary rules to achieve their stabilization objectives. Tunisia has to grant more weight to inflation, Morocco has to grant a similar weight to inflation, activity and exchange rate while Algeria has to grant more weight to activity.
It follows that the application of a unique monetary policy over the whole zone of Maghreb would not be beneficial for all countries.
However, even though there is strong heterogeneity, the Maghreb can draw numerous lessons from monetary integration experiences. These show that the movement towards the creation of a regional monetary union presupposes certain conditions that would be necessary to ensure the

[††††††††††††] In this respect, an evaluation of the effects of introducing a common monetary policy, by identifying a Taylor rule for the whole area could be fruitful.

long term success of the monetary integration process. The MC must opt for gradualism, deepening the national and regional financial integration, promoting the banking competition, intensifying the banking sector solidity, diversifying the production notably through a commercial liberalization (in order to reduce the effects of independence) as well as improving coordination of financial, monetary and exchange rate policies to guarantee the success of Maghreb monetary integration process.

In the same vein, they have to outshine their political conflicts and further improve their financial and budgetary situation.

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Appendix:

Table 1: Result of Phillips Perron test‡‡‡‡‡‡‡‡‡‡‡‡

Tunisia	*PP*	*Model (1)*	*Model (2)*	*Model (3)*
Growth rate (y)	Level First difference	-2.78***	-5.58***	-6.57***
Inflation rate (π)	Level First difference	-10.86***	-14.2***	-14.55***
Real money rate $(i_t - \pi_t)$	Level First difference	-2.52** -6.07***	-1.23 -6.59***	-1.13 -6.67***
Real exchange rate (e)	Level First difference	-1.16 -7.79***	0.57 -7.9***	-1 -8.73***
Morocco	*PP*	*Model (1)*	*Model (2)*	*Model (3)*
Growth rate (y)	Level First difference	-5.74***	-7.77***	-8.94***
Inflation rate (π)	Level First difference	-14.67***	-39.62***	-51.04***
Real money rate $(i_t - \pi_t)$	Level First difference	-1.94** -6.54***	-0.48 -6.81***	-2.07 -6.75***
Real exchange rate (e)	Level First difference	0.2 -7.83***	-1.42 -7.94***	-1.44 -10.86***
Algeria	*PP*	*Model (1)*	*Model (2)*	*Model (3)*
Growth rate (y)	Level First difference	-3.39***	-4.57***	-6.59***
Inflation rate (π)	Level First difference	-28.68***	-88.93***	-88.31***
Real money rate $(i_t - \pi_t)$	Level First difference	-1.28 -5.6***	-0.31 -5.73***	-1.94 -5.72***
Real exchange rate (e)	Level First difference	-2.06**	-3.91***	-4.07**

‡‡‡‡‡‡‡‡‡‡‡‡ *** Significant at the 1% level. ***significant at the 5% level. *significant at the 10% level.
Model (1): Without Constant and Trend. Model (2): With Constant. Model (3): With Constant and Trend.

Table 2: Result of Johansen test§§§§§§§§§§§§

Tunisia	*Model (1)*		*Model (2)*		*Model (3)*	
TCR – TMR	Trace statistic	0.05 critical value	Trace statistic	0.05 critical value	Trace statistic	0.05 critical value
None	14.32	12.32 (0.02)	15.13	20.26 (0.21)	9.73	15.49 (0.3)
At most 1	5.16	4.12 (0.02)	5.38	9.16 (0.24)	0.6	3.84 (0.43)

TCR - TMR	Max-Eigen statistic	0.05 critical value	Max-Eigen statistic	0.05 critical value	Max-Eigen statistic	0.05 critical value
None	9.15	11.22 (0.11)	9.74	15.89 (0.35)	9.12	14.26 (0.27)
At most 1	5.16	4.12 (0.02)	5.38	9.16 (0.24)	0.6	3.84 (0.43)

Morocco	*Model (1)*		*Model (2)*		*Model (3)*	
TCR – TMR	Trace statistic	0.05 critical value	Trace statistic	0.05 critical value	Trace statistic	0.05 critical value
None	10.38	12.32 (0.1)	17.57	20.26 (0.11)	13.39	15.49 (0.1)
At most 1	1.68	4.12 (0.22)	7.31	9.16 (0.11)	3.39	3.84 (0.06)

TCR - TMR	Max-Eigen statistic	0.05 critical value	Max-Eigen statistic	0.05 critical value	Max-Eigen statistic	0.05 critical value
None	8.7	11.22 (0.13)	10.25	15.89 (0.31)	10	14.26 (0.21)
At most 1	1.68	4.12 (0.22)	7.31	9.16 (0.11)	3.39	3.84 (0.06)

§§§§§§§§§§§§ Model (1): Without Constant and Trend. Model (2): With Constant. Model (3): With Constant and Trend.

Algeria	*Model (1)*		*Model (2)*		*Model (3)*	
TCR – TMR	Trace statistic	0.05 critical value	Trace statistic	0.05 critical value	Trace statistic	0.05 critical value
None	5.3	12.32 (0.52)	22.88	20.26 (0.02)	19.99	15.49 (0.00)
At most 1	1.26	4.12 (0.30)	2.78	9.16 (0.62)	0.16	3.84 (0.68)

TCR - TMR	Max-Eigen statistic	0.05 critical value	Max-Eigen statistic	0.05 critical value	Max-Eigen statistic	0.05 critical value
None	4.04	11.22 (0.62)	20.09	15.89 (0.01)	19.82	14.26 (0.00)
At most 1	1.26	4.12 (0.30)	2.78	9.16 (0.62)	0.16	3.84 (0.68)

Table 3: Optimal lags for each country

	1st equation			*2nd equation*			*3rd equation*		
	$A(L)$	$B(L)$	$C(L)$	$D(L)$	$E(L)$	$F(L)$	$G(L)$	$H(L)$	$K(L)$
Tunisia	4	1	2	1	1	2	1	5	2
Morocco	4	1	1	3	3	2	4	3	1
Algeria	3	2	1	2	1	3	1	1	1

Table 4: Results of optimisation

	α	β	δ	Loss function
Tunisia	4.6	6.0	0.1	230.333
Morocco	1.1	1.1	1.1	10.7745
Algeria	1.6	1.1	0.1	71.549

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